

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

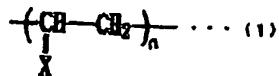
Claim 1 (withdrawn): A multilayer printed circuit board comprising a substrate board and, as built up on said substrate

board successively and alternately, a conductor circuit and a resin insulating layer at a plurality of levels, with said conductor circuits being interconnected by way of via holes, wherein said resin insulating layer is composed of a polyolefin resin.

Claim 2 (withdrawn): The multilayer printed circuit board according to Claim 1 wherein said polyolefin resin is a thermosetting polyolefin resin or a thermoplastic polyolefin resin.

Claim 3 (withdrawn): The multilayer printed circuit board according to Claim 2 wherein the thermoplastic polyolefin resin has a melting point of not less than 200°C.

Claim 4 (withdrawn-currently amended): The multilayer printed circuit board according to Claim 1 wherein said polyolefin resin is a resin composed of one species of the repeating unit represented by the following chemical formula (1) or a resin comprising a copolymer of two or more different species of the repeating unit represented by said formula (1)

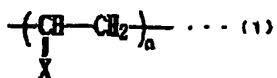


wherein n represents 1 to 10000; X represents a hydrogen atom, an alkyl group, a phenyl group, a hydroxyl group, an unsaturated hydrocarbon residue having 2 to 3 carbon atoms, an oxide

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

group or a lactone group.

Claim 5 (withdrawn-currently amended): The multilayer printed circuit board according to Claim 1 wherein said polyolefin resin is a resin which has a repeating unit represented by the following chemical formula (1) and contains a double bond, an oxide structure, a lactone structure or a mono- or polycyclopentadiene structure in its backbone chain[[.]]:



wherein n represents 1 to 10000; X represents a hydrogen atom, an alkyl group, a phenyl group, a hydroxyl group, an unsaturated hydrocarbon residue having 2 to 3 carbon atoms, an oxide group or a lactone group.

Claim 6 (withdrawn): A multilayer printed circuit board wherein the polyolefin resin is a mixed resin of two or more species of the polyolefin resin according to Claim 4, a resin composed of two or more polyolefin resin crosslinked to one another according to Claim 4, or a mixed resin comprising a polyolefin resin selected from the polyolefin resin according to Claim 4 and a thermosetting resin.

Claim 7 (withdrawn): The multilayer printed circuit board according to Claim 1 wherein said conductor circuit is constructed on the resin insulating layer by way of a metal layer composed of at least one metal selected from among the metals (exclusive of Cu) of the 4th to 7th periods in Group 4A through Group 1B of the long-form periodic table of the elements, Al and Sn.

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

Claim 8 (withdrawn): The multilayer printed circuit board according to Claim 1 wherein said metal layer is disposed on a flat and level resin insulating layer.

Claim 9 (withdrawn): The multilayer printed circuit board according to Claim 1 wherein said resin insulating layer has a surface obtained by plasma treatment or corona discharge treatment.

Claim 10 (withdrawn): The multilayer printed circuit board according to Claim 1 wherein said substrate board is a board carrying the conductor circuit on its surface or inside.

Claim 11 (withdrawn): A multilayer printed circuit board comprising a substrate board and, as built up on said substrate board successively and alternately, a conductor circuit and a resin insulating layer at a plurality of levels, with said conductor circuits being interconnected by way of via holes, wherein said resin insulating layer comprises a cycloolefin resin.

Claim 12 (withdrawn): The multilayer printed circuit board according to Claim 11 wherein said dielectric constant of said resin insulating layer at 1 GHz is not more than 3.0 and the dielectric loss tangent of the same layer is not more than 0.01.

Claim 13 (withdrawn): The multilayer printed circuit board according to Claim 11 wherein said cycloolefin resin is a homopolymer or copolymer of 2-norbornene, 5-ethylidene-2-norbornene and/or any of their derivatives.

Claim 14 (withdrawn): The multilayer printed circuit board according to Claim 11 wherein said cycloolefin resin is a thermosetting cycloolefin resin.

Claim 15 (withdrawn): A process for manufacturing a multilayer printed circuit board comprising a substrate board and, as built up on said substrate board successively and alternately,

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

a conductor circuit and a resin insulating layer at a plurality of levels with said conductor circuits

being interconnected by way of via holes,

which comprises laminating a film comprising cycloolefin resin on a conductor circuit formed on
said substrate board by press lamination of an interlayer resin insulating layer under vacuum or
reduced pressure.

Claim 16 (withdrawn): The process for manufacturing a multilayer printed circuit board
according to Claim 15 wherein the interlayer resin insulating layer composed of a cycloolefin
resin is formed on the conductor circuit formed on the substrate board and then openings for via
holes are formed in said interlayer resin insulating layer by irradiation with a laser beam.

Claim 17 (withdrawn): A multilayer printed circuit board comprising a substrate board
carrying a lower-layer conductor circuit and as built up thereon successively and alternately, an
interlayer resin insulating layer and an upper-layer conductor layer, which further comprises a
metal layer composed of at least one metal selected from among nickel, cobalt, tin and noble
metals as formed at least on the surface of said lower-layer conductor circuit and a roughened
layer composed of Cu-Ni-P alloy as formed on said metal layer.

Claim 18 (withdrawn): The multilayer printed circuit board according to Claim 17
wherein said interlayer resin insulating layer is provided with via holes, said via holes being
electrically connected to said lower-layer conductor circuit formed on the substrate board by way
of said metal layer composed of at least one metal selected from among nickel, cobalt, tin and
noble metals and said roughened layer.

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

Claim 19 (withdrawn): The multilayer printed circuit board according to Claim 17 wherein said roughened layer is covered with a metal layer containing at least one metal having the ionization tendency higher than copper but not higher than titanium or a noble metal layer.

Claim 20 (withdrawn): The multilayer printed circuit board according to Claim 17 wherein said via holes are filled with a plated film.

Claim 21 (withdrawn): A process for manufacturing a multilayer printed circuit board which comprises forming a resin insulating layer and a conductor circuit on a resin substrate, which further comprises forming a metal layer composed of at least one metal selected from among the metal elements of the 4th through 7th periods in Group 4A through Group 1B of the long-form periodic table of the elements, Al and Sn on the surface of said resin insulating layer, then cleaning the surface of said metal layer with an acid and thereafter constructing the conductor circuit on said metal layer.

Claim 22 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 21 wherein said at least one metal selected from among the metal elements of the 4th through 7th periods in Group 4A through Group 1B of the long-form periodic table of the elements, Al and Sn is at least one metal selected from among Ni, Cr, Mo, Ti, W, Cu, Al, Sn, Pt, Pd and Au.

Claim 23 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 21 wherein said resin insulating layer has a flat and level surface.

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

Claim 24 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 21 wherein said acid is an acid selected from among hydrochloric acid, sulfuric acid, acetic acid and phosphoric acid or a mixture of such acids.

Claim 25 (currently amended): A multilayer printed circuit board comprising:
~~a resin substrate board carrying having, on both sides thereof, first resin insulating layers each comprised of the same resin material; and a conductor circuit built on each of said resin insulating layers,~~

a lower metal layer, having a conductor circuit made of metal and having the same pattern as said lower metal layer, on each of said first resin insulating layers; and

wherein

said resin insulating layers comprise thermosetting polyolefin resin[.]; and

~~or a mixed resin of a thermosetting resin containing at least one member selected from among thermosetting polyolefin resin, epoxy resin, polyimide resin, phenolic resin and bis (maleimide) triazine resin, and a thermoplastic resin, and~~

~~each of said conductor circuits are formed on the surfaces of said resin insulating layers by way of a metal layer~~

said lower metal layers are composed of at least one metal selected from among metals (exclusive of Cu) of the 4th through 7th periods in Group 4A through Group 1B of the long-form periodic table of the elements, Al, and Sn.

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

Claim 26 (currently amended): The multilayer printed circuit board according to Claim 25 wherein each of said lower metal layers is a layer containing at least one metal selected from among Al, Fe, W, Mo, Sn, Ni, Co, Cr, Ti and noble metals.

Claim 27 (currently amended): The multilayer printed circuit board according to Claim 25 wherein each of said first resin insulating layers has a flat and level surface.

Claim 28 (canceled).

Claim 29 (currently amended): The multilayer printed circuit board according to Claim 25 wherein each of said first resin insulating layers has a surface obtained by plasma treatment or corona discharge treatment.

Claim 30 (currently amended): The multilayer printed circuit board according to Claim 25 wherein

each of said conductor circuits has an upper metal layer on its surface;
said upper a metal layer is composed of at least one metal selected from among metals (exclusive of Cu) of the 4th through 7th periods in Group 4A through Group 1B of the long-form periodic table of the elements, Al, and Sn; and on its surface and
said upper metal layer ~~on the surface of said conductor circuits has an interlayer~~ a second resin insulating layer or a solder resist layer ~~built~~ thereon.

Claim 31 (currently amended): The multilayer printed circuit board according to Claim 25 wherein each of said lower metal layers ~~built~~ on the surface of said first resin insulating layers has a Cu layer formed on its surface, and

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

~~said conductor circuit is constructed on said Cu layer has a conductor circuit constructed thereon.~~

Claim 32 (currently amended): The multilayer printed circuit board according to Claim 25 wherein the thickness of each of said lower metal layers is 0.01 to 0.2 μ m.

Claim 33 (withdrawn): A multilayer printed circuit board comprising a resin substrate board and as built up on both sides thereof, a lower layer conductor circuit with the conductor circuits interconnected by plated-through holes, an interlayer resin insulating layer formed on said lower-layer conductor circuit, and an upper-layer conductor circuit formed on said interlayer resin insulating layer,

wherein said lower-layer conductor circuit is, on at least part of the surface thereof, provided with a metal layer composed of at least one metal selected from among the metals (exclusive of Cu) of the 4th through 7th periods in Group 4A through Group 1B of the long-form periodic table of the elements, Al and Sn.

Claim 34 (withdrawn): The multilayer printed circuit board according to Claim 33 wherein said metal layer is formed from at least one metal selected from among Al, Fe, W, Mo, Sn, Ni, Co, Cr, Ti and noble metals.

Claim 35 (withdrawn): The multilayer printed circuit board according to Claim 33 wherein said resin insulating layer is composed of a thermosetting polyolefin resin or a thermoplastic polyolefin resin.

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

Claim 36 (withdrawn): The multilayer printed circuit board according to Claim 33 wherein said interlayer resin insulating layer has a flat and level surface with an average roughness value of Ra being not more than 1 μ m.

Claim 37 (withdrawn): A process for manufacturing a multilayer printed circuit board which comprises forming a conductor layer on both sides of a resin substrate board, disposing a plating resist according to a designed circuit pattern on said conductor layer, forming a plated film in the area not covered with the plating resist, removing said plating resist, etching the conductor layer under said plating resist to provide a lower-layer conductor circuit, forming an interlayer resin insulating layer over said lower-layer conductor circuit and forming an upper-layer conductor circuit by way of the interlayer resin insulating layer on the lower-layer conductor circuit wherein, after forming said plated film in said area not covered with the plating resist, a metal layer composed of at least one metal selected from among the metals (exclusive of Cu) of the 4th to 7th periods in Group 4A through Group 1B of the long-form periodic table of the elements, Al and Sn is formed on at least part of the surface of said plated film.

Claim 38 (withdrawn): A process for constructing a conductor circuit which comprises at least the following three steps (1) to (3):

- (1) a step of constructing a first conductor layer composed of a metal forming a passivation film on surface on an insulating substrate board,
- (2) a step of constructing a second conductor layer composed of a metal having the ionization tendency lower than said metal forming a passivation film on surface on said first conductor layer, and

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

(3) a step of performing selective etching with an acid etching solution to simultaneously etch off the first and second conductor layers in the non-conductor circuit-forming region.

Claim 39 (withdrawn): The process for constructing a conductor circuit according to Claim 38 wherein said metal forming a surface passivation layer is at least one metal selected from among Ni, Co, Cr, Ti, Nb, Ta and Al.

Claim 40 (withdrawn): The process for constructing a conductor circuit according to Claim 38 wherein said metal forming a surface passivation metal is Ni and said second conductor layer composed of a metal having the ionization tendency lower than Ni is a layer composed of at least one metal selected from among Cu, Sn and Pb.

Claim 41 (withdrawn): The process for constructing a conductor circuit according to Claim 38 wherein said metal forming a passivation film on surface is Al and said second conductor layer composed of a metal having the ionization tendency lower than Al is composed of at least one metal selected from among Cu, Sn, Pb and Fe.

Claim 42 (withdrawn): The process for constructing a conductor circuit according to Claim 38 wherein said acid etching solution is an aqueous solution of sulfuric acid, an aqueous solution of hydrogen chloride or an aqueous mixed solution of sulfuric acid and hydrogen peroxide.

Claim 43 (withdrawn): A process for manufacturing a multilayer printed circuit board comprising forming a resin insulating layer and a conductor circuit on an insulating substrate board, which comprises at least the following steps (1) to (5):

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

- (1) a step of constructing a first conductor layer composed of a metal forming a surface passivation layer on the resin insulating layer,
- (2) a step of constructing a second conductor layer composed of a metal having the ionization tendency lower than said metal forming a passivation film on surface on said first conductor layer,
- (3) a step of disposing a plating resist on said second conductor layer,
- (4) a step of constructing a third conductive layer by electroplating on said second conductor layer provided with said plating resist, and
- (5) after removal of the plating resist, a step of simultaneously etching the first and second conductor layers under said plating resist with an acid etching solution.

Claim 44 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 43 wherein said metal forming a passivation film on surface is at least one metal selected from among Ni, Co, Cr, Ti, Nb, Ta and Al.

Claim 45 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 43 wherein said metal forming a passivation film on surface is Ni and said second conductor layer composed of a metal having the ionization tendency lower than Ni is a layer composed of at least one metal selected from among Cu, Sn and Pb.

Claim 46 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 43 wherein said metal forming a passivation film on surface is Al and said second conductor layer composed of a metal having the ionization tendency lower than Al is a layer composed of at least one metal selected from among Cu, Sn, Pb and Fe.

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

Claim 47 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 43 wherein said acid etching solution is an aqueous solution of sulfuric acid, an aqueous solution of hydrogen chloride or an aqueous mixed solution of sulfuric acid and hydrogen peroxide.

Claim 48 (withdrawn): A method of forming a metal film which comprises removing an oxide film on the surface of a nickel film using an aqueous solution of a reducing acid having a concentration of 2.0 to 10.0 mol/L and then forming a different metal film on the surface of said nickel film.

Claim 49 (withdrawn): The method of forming a metal film according to claim 48 wherein said aqueous solution of a reducing acid is hydrochloric acid or hydrofluoric acid.

Claim 50 (withdrawn): The method of forming a metal film according to Claim 48 wherein the concentration of said reducing acid solution is 4.0 to 8.0 mol/L.

Claim 51 (withdrawn): A process for manufacturing a multilayer printed circuit board which comprises (1) a step of forming an interlayer resin insulating layer on a substrate board formed with a lower-layer conductor circuit and forming openings for via holes in said interlayer resin insulating layer, (2) a step of forming a metal film on said interlayer resin insulating layer, (3) a step of disposing a plating resist on said metal layer, (4) a step of performing electroplating and then forming a nickel film to construct an electroplated film and a nickel film among said plating resists, (5) a step of removing said plating resist and etching said metal layer under said plating resist to thereby construct an upper-layer conductor circuit and via holes and (6) a step of forming a roughened layer composed of Cu-Ni-P alloy on said upper-layer conductor circuit

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

wherein, following said step (5), the oxide film on the surface of said nickel film is removed with an aqueous solution of a reducing acid having a concentration of 2.0 to 10.0 mol/L.

Claim 52 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 51 wherein said aqueous solution of a reducing acid is hydrochloric acid or hydrofluoric acid.

Claim 53 (withdrawn): The process for manufacturing a multilayer printed circuit board according to Claim 51 wherein the concentration of said aqueous reducing acid solution is 4.0 to 8.0 mol/L.

Claim 54 (withdrawn): A multilayer printed circuit board comprising a substrate board carrying a lower-layer conductor circuit and, as built up on the substrate board successively and alternately, an interlayer resin insulating layer and an upper-layer conductor circuit in succession, which further comprises a metal layer composed of at least one metal selected from among metals having ionization tendencies not lower than tin but not higher than aluminum and noble metals as formed on the surface of said lower-layer conductor circuit and a roughened layer superimposed on said metal layer.

Claim 55 (withdrawn): The multilayer printed circuit board according to Claim 54 wherein said at least one metal selected from among metals having ionization tendencies not lower than tin but not higher than aluminum and noble metals is at least one metal selected from among aluminum, chromium, iron, zinc, nickel, cobalt, tin and noble metals.

Claim 56 (withdrawn): The multilayer printed circuit board according to Claim 54 wherein said roughened layer is a layer composed of Cu-Ni-P alloy.

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

Claim 57 (withdrawn): The multilayer printed circuit board according to Claim 54 wherein said interlayer resin insulating layer is provided with via holes, said via holes being electrically connected to said lower-layer conductor circuit constructed on the substrate board by way of said metal layer composed of at least one metal selected from among metals having ionization tendencies not lower than tin but not higher than aluminum and noble metals and said roughened layer.

Claim 58 (withdrawn): The multilayer printed circuit board according to Claim 54 wherein said roughened layer is covered with a layer containing one or more metals having ionization tendencies higher than copper but not higher than titanium or a noble metal layer.

Claim 59 (withdrawn): The multilayer printed circuit board according to Claim 54 wherein said via holes are filled with a plated metal.

Claim 60 (withdrawn-currently amended): A process for manufacturing a multilayer printed circuit board which comprises constructing a conductor circuit, roughening the conductor circuit to provide a roughened surface, forming an interlayer resin insulating layer over the roughened surface of the conductor circuit and forming openings for via holes in a repeated sequence to construct conductor circuits comprised a plurality of layers isolated by interlayer resin insulating layers, wherein, after forming the roughened surface on the conductor circuit, the oxidation treatment is ~~carried~~ carried out to provide an oxide film on the entire roughened surface and, thereafter, said interlayer resin insulating layer is constructed.

Claim 61 (withdrawn): The process for manufacturing a multilayer printed circuit board according to claim 60 wherein, after forming the roughened surface on the conductor circuit, the

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

roughened surface is oxidized by heating in the atmospheric air at 80 to 200°C for 10 minutes to 3 hours to thereby provide an oxide film on the entire roughened surface thereof.

Claim 62 (withdrawn): A multilayer printed circuit board comprising a substrate board and, as successively built thereon, a conductor circuit provided with a roughened surface and an interlayer resin insulating layer provided with openings for via holes, said openings for via holes being filled with a conductor, which further comprises an oxide film layer covering the whole surface of the conductor circuit provided with the roughened surface.

Claim 63 (withdrawn): The multilayer printed circuit board according to Claim 62 wherein the thickness of the covering layer comprising an oxide film is 0.01 to 0.2 μ m.

Claim 64 (currently amended): The multilayer printed circuit board according to Claim 25 wherein each of ~~the said lower~~ metal layers ~~are~~ is formed by plating, ~~PVD~~ physical vapor deposition or ~~CVD~~ chemical vapor deposition.

Claim 65 (currently amended): The multilayer printed circuit board according to Claim 25 wherein said thermosetting polyolefin resin has a dielectric constant value of not more than 3 and a dielectric loss tangent value of not more than 0.05.

Claim 66 (canceled).

Claim 67 (new): The multilayer printed circuit board according to Claim 25 comprising a successive series of units, each unit comprising the first resin insulating layer, the lower metal layer on said first resin insulating layer and the conductor circuit on said lower metal layer.

AMENDMENT UNDER 37 C.F.R. 1.111
U.S. Application No. 09/806,203

Claim 68 (new): The multilayer printed circuit board according to Claim 30 comprising, on said second resin insulating layer, another lower metal layer on said second resin insulating layer, and another conductor circuit made of metal on said another lower metal layer.